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explanations not applicable to the entire series of similar facts ; he more and more simplifies the question until the solution is derived from this analysis.

[*To be continued.*]

THE PRIMITIVE PERIOD OF THE HUMAN SPECIES.*

BY CARL VOGT.

It is proper that, in a new organ for the natural and primitive history of man, the starting point from which it proceeds should be well fixed and in outlines, at least, the position defined, which science occupies in relation to certain questions. It cannot be our purpose here exhaustively to treat a subject still under investigation. Our object is rather to seize some prominent facts which may serve as boundary-stones, between which the subordinate results may be arranged. We cannot conceal from ourselves that such a selection presents difficulties, since on the one hand the number of discoveries daily increases—nay, owing to the extraordinary zeal with which the investigations are carried on, they swell to an enormous mass ; whilst on the other hand facts apparently insignificant come to light, which by subsequent discoveries acquire the greatest importance. Here, it must also be confessed, our knowledge is, more than on other questions, patchwork, so that in arranging the results we in some degree resemble the artist who is engaged in re-arranging the scattered little variegated stones of a destroyed mosaic pavement. It cannot fail that in such a work many errors of association must occur, and that a recovered missing stone may upset the whole combination. But such cases are also instructive, inasmuch as they invite us to caution and to close examination.

My purpose at present is to treat of the oldest documents we possess relative to the existence of man, without reference to periods approaching historical events. I therefore, putting aside the so-called bronze-period, shall exclusively speak of the stone-period, during which stones, wood and bones were the three chief materials of which implements were constructed. I do not so much purpose to cite the facts, as critically to examine, how far the findings are trust-

* This article is a translation from the *Archiv für Anthropologie*, and we have given it a place in our pages as a specimen of what our admirable contemporary is publishing.—EDITOR.

worthy, and how far we might succeed from the results obtained, to determine the period and the progress of civilisation in primitive times.

It never occurred to me, as some have done, abruptly to divide stone, bronze, and iron periods. Some little reflection clearly leads to the assumption that on the introduction of a new element of culture the preceding condition cannot cease at once. Whether bronze was in our part of the world independently used, or whether, as seems more probable, it was introduced by a more civilised people on the shores of the Mediterranean, or from the coast of Africa; this much is certain, that bronze made its way but slowly, and that stone and bone implements remained in use long after the introduction of bronze articles by trade, and even after such articles were fabricated in the respective countries themselves. The Homeric heroes, who knew bronze and iron, threw stones at each other, and the sling was, in not very remote times, a legitimate war weapon. It also appears that stone implements, even after they had disappeared from general use by the introduction of metals, retained an odour of sanctity, so that stone-knives and stone-hatchets were used in religious ceremonies, it being considered that metal which required so much human labour was rendered unclean by so much handling.

But are we from this transition of one epoch into another justified, as some have done, in inferring that no preceding distinct epoch had existed, and that when in certain spots we only find stone and bone implements, it was merely accidental that no bronze was deposited? It would be foolish to deny that in some cases this may have occurred. But if, on the other hand, the results of many researches agree that there were periods of culture which did not betray any trace of the knowledge of metals, and that stone and bone implements were exclusively used for purposes to which at later periods metal was applied, every unprejudiced inquirer must at once admit that such an epoch has really existed, and that we even distinguish in its progressive periods of development, civilisation.

It may be that a grave, for instance, containing only stone implements, belongs to a comparatively recent period, especially as on account of the above mentioned religious character, these stone implements were perhaps preferentially deposited. But the absence of metal loses its accidental character, when we meet with numerous settlements or stations, when hundreds of caves or graves are explored, where not only metal is entirely absent, but where the discoveries of remains of foreign species of animals, testify to a state of culture resembling those of savages subsequently discovered.

In mentioning savages I must be permitted to offer an observation.

Certain as it is that stone, bronze, and iron periods only form relative sections continued into one another, it cannot be assumed that similar civilisation epochs were simultaneously developed in different parts of the globe. In other words, even in the limited area of Europe, there may, on the coasts and on rivers, peoples have existed, further advanced in civilisation, who knew of and how to use metals; whilst in the interior of the country tribes dwelt, who for centuries, perhaps, had no idea of metals, not unlike the savages of islands who used stone weapons until Europe supplied them with iron, lead, and powder. It is therefore, in my opinion, improper to associate the findings of different countries, lying so far apart, instead of only comparatively treating them, and at first merely approximately to determine the period of the development of a given civilisation. It is, for instance, imaginable that in the Alpine highlands, especially in the northern declivity of Switzerland and the adjoining regions, the knowledge of metals was unknown to the pile builders; whilst around the Mediterranean, and specially on the southern and eastern coasts, the knowledge of metals was generally diffused. The more therefore these researches extend, the more must they be applied to definite regions, and be confined within narrower limits in the comparison of results, within which an arrangement of such results becomes possible.

Since the publication of my *Lectures on Man*, which were not exhaustive, but merely to further researches, materials have in all countries wonderfully increased. Efforts are now making in all parts of Europe, to dig up the treasures concealed in the soil, and new finds are brought to light which supplement the existing. In referring to what is known I shall confine myself to what is essential for the purpose of connection.

The minute exploration of caves and their contents has been carried on with great zeal, specially in France, and also in Italy and Belgium. Everywhere have the researches been carried on with the avowed object of arranging the obtained results in their proper series. The contents of a cave are no longer, as formerly, considered as a whole, but a distinction is made between natural deposits and the changes produced by man in different periods. There is no doubt that many caves have been filled up solely by brooks and streams, which reached the elevations at which the entrances to the caves are now found. In some caves we have succeeded to determine the intermediate periods of successive deposits differently characterised.

But although there are many caves recognised as containing deposits in their original natural condition, it cannot be denied that there are many other caves in which the original deposits have been disturbed

and mingled with products belonging to later and recent times. Many caves served as places of sepulchre or refuges in troublous times, or as dwelling places for hunters, shepherds, etc. In the places for refuge the dwellers left behind, their fire-places, portions of their meals, and implements which mingled with the relics of remote epochs. Beasts of prey inhabited the caves, and introduced into them bones of animals. There are thus caves containing samples of prehistoric and historic periods, which are apt to throw suspicion on the results of other investigations. Fortunately most investigators are at present fully alive to this difficulty, and by close attention endeavour to prevent any confusion. Where the natural deposits present themselves clearly and perfectly, where the stalactites which separate generally the deposits are perfectly uninjured, and where no trace is found of any disturbance we are justified in assuming that the finds are genuine, especially if they be of such a nature as to show a decided difference in the various periods of deposition. However reliable cave finds may be in normal cases, the severest examination is requisite to avoid errors. Where we have the least doubt whether we are in the presence of undisturbed original deposits, we ought to be careful in drawing conclusions from the facts. On the other hand, it appears to us foolish that because caves have been found disturbed no valid results can be obtained from the exploration of caves. This appears to me not unlike the assertion that because there are some churchyards in which after some thirty years the old graves are again made use of, all old churchyards must necessarily contain bodies of a recent period. There are, nevertheless, unquestionably churchyards in which for centuries no corpse had been interred, and where we may be sure that all objects found in them, of whatever kind they might be, must date from a period preceding the abandonment of the burial place. Just so with the caves. If we find in the soil beds containing only bones of the cave bear and cave hyæna, and other contemporaneous species, and above them an undisturbed stalactite roof, and above this another deposit of reindeer bones, and those of other animals contemporaneous with the reindeer; it would be impossible to find more convincing proofs of two successive periods differing from each other in their fundamental characters.

Of not less importance is the examination of the beds of the so-called diluvium, the conventional name of which conceals a sense which modern geology can no longer recognise. It must be insisted upon that no geological fact is in the least capable of affording any proof of a universal deluge in a comparatively recent period at all approaching historical times. All the facts, of whatever kind they may be, merely indicate deposits which, in the existing valleys, rose to a

comparatively small height, partly owing to changes of level, and which, though considerable for the respective regions, are insignificant when taken on the whole. It is now proved by incontestable evidence that the so-called diluvial period lasted a comparatively immeasurable long time within which the expansion of the glaciers induced great changes on the surface of Central Europe, and which preceded the arrival of man.

On referring to the various climatic conditions which obtained during this period, we observe that a great portion of Central Europe had at that time, in relation to climate and the *Fauna* and *Flora* depending thereon, an insular character resembling in some degree that of the southern islands of New Zealand. The glaciers could thus descend from the mountain heights into the valleys, where there existed a southern vegetation, and the elephant and rhinoceros could find the means of existence at the foot of the glaciers despite the adjoining ice mountains. When we consider that the glaciers surrounding Mount Cook, in New Zealand, descend to the region of ferns and palms, because the insular climate preserves them by the great quantity precipitated from the heights, whilst by moderating the heat of the summer it prevents their melting, we ought not to be surprised at finding in the circumference of the Alps in the diluvium produced by the glaciers elephant bones, or doubt that these regions were at a former period inhabited by pachydermata.

Whilst the exploration of caves presents peculiar difficulties, those attending the explorations of the diluvium are not much less perplexing, which is abundantly proved by the lively discussions on this subject in the French Academy. There are two special conditions which require our attention. First, the local difference of the deposits. In this respect we may say that not merely every country, but that every river bed and every valley has its own law. That there was a deposit here and none there; that the character of these deposits (gravel, sand, mud, etc.) varies and alternates greatly; that even deposits in adjoining localities, manifestly formed simultaneously, may present entirely different characters. It is, therefore, exceedingly difficult to parallelise the various deposits characterising the diluvium, and for the present, at least, to determine the chronological succession in which certain formations of different countries stand to each other; especially as the stratification which guides us in elder beds is in the diluvium very confused, and offers no certain basis for tenable inferences.

Another difficulty has been pointed out by Chevalier De Beaumont. Diluvial formation is constantly taking place; every little brook carries off some particles into the depth. That this restlessness, so to speak, of the earthy particles by the influence of the water acts also

in the depth, has been proved by the exploration of sepulchres, when it was found that the slightest gap in a sarcophagus was sufficient to give rise to accumulation within, which gradually not merely displaced the bones but by pressure changed their forms. The alluvial formations of the slopes, as Elie De Beaumont calls them, are, no doubt, continuous, and deposits may thus take place which, coming from heights, may present features of being older than they actually are.

We must, however, not forget that these phenomena are well-known to the geologist, and that we no longer live in the infancy of the science, when surprise was felt that, for instance, in the lower tertiary strata of Paris sea-urchins were found which belong to the chalk, but had been carried off and deposited in the tertiary strata. It cannot, therefore, be denied that alluvial formations still take place in which the products of former and later periods are commingled. Thus a river running through sand-banks belonging to different periods of formation, may mingle portions of these sand-banks in a new alluvial formation ; but a minute examination of local conditions will also here lead to a satisfactory answer to questions of this kind. If above such deposits, accumulated in slopes, later deposits are found bearing a well defined periodical character, we may at least assume this much that the lower beds must belong to an older epoch.

The peat moors have contributed much to throw light upon certain periods of civilisation, and have yielded rich and genuine results, but unfortunately they reach only to a certain period. In the oldest period here treated of they were not inhabited, and can, therefore, afford us no clue ; but they acted as excellent preservers of objects of later periods. It is true that it may give rise to a source of errors, because heavy objects especially may, in the peat moors, sink so deep as to be believed to have originally belonged to this stratum. But this sinking cannot be appealed to when we come to settlements with piles driven in the subsoil. With regard to an individual tree hollowed out for a boat, like that of the Nidan-moor, which caused M. Franz Maures to sing a song of triumph, there may be doubts which, however, must vanish before universal phenomena. If, therefore, peat moors give, as regards a relative period within which the deposits took place, a satisfactory explanation, I cannot help again drawing attention that in the peat moors alone we must look for the determination of the actual period within which the pile villages existed. Although we all at the present time in botanical and chemical respects very nearly understand the formation of peat, still the question of the growth of peat within a definite time is by no means solved. We neither know generally within what time a stratum of peat one foot thick may grow, nor do we possess any scientific data to calculate the quantity of

growth within a given time of any individual peat moor. That the growth must differ in various moors; that even in a given locality they must have differed during certain periods is easily imaginable; but I repeat that by minute researches in individual peat moors, which are as yet entirely wanting, we may succeed in establishing chronological determinations of the age of pile buildings.

We can only assign to the deposits in the open lakes a secondary rank to those of the peat moors, as regards the certainty of results. Although this kind of fishing is now carried on with the greatest zeal, nay, with a certain passion, it is clearly perceivable that the openness of the lakes must, in such places where settlements existed, have mixed products of different epochs. The celebrated Steinberg of Nidan has existed as a settlement from the stone to the iron period; it is impossible to assign to any object found there a chronological date.

Old graves form another source of our prehistoric knowledge. It will, indeed, have to be acknowledged that in the most primitive times burial places, properly so-called, were unknown, and that care for the dead of relations already indicates a progress of culture even before the development of religious feelings. Burial places with their contents will, therefore, although open to chronological doubts, present to us a greater interest, since the rarity of skulls in other deposits obliges us to seek for them in burial places.

The chronological question is a very important one. That these investigations concern a primeval period, of which even tradition renders no account, is now generally acknowledged; nor can it be contested that the existence of man can be traced at least to an epoch during which extinct species of animals inhabited our continent. But between this starting point and historical times intervene a series of periods or epochs which are to be partly demarcated and chronologically determined. What means do we possess for such a purpose, and what results have we already obtained?

I have already in my *Lectures* indicated that the chronological attempts of Gilleron, Morlot, and Troyon in Switzerland have no pretensions to scientific accuracy, and although this may not altogether apply to the excavations of Hekekyan Bey in Egypt nor to the computations of Dr. Dowler, of New Orleans, even these are open to criticism. These experiments lie rather outside of accurate supervision, and although I am perfectly convinced that the computations to which they lead are not exaggerated, I would not altogether rely upon these foreign results. They constitute, however, at present the only attempts chronologically to determine prehistoric times, and should find grateful acknowledgment, even if unsuccessful.

In the absence of a chronological determination of periods, we must be permitted to follow a method applied to geology. We do not in geology ask how many years have passed since this or that stratum has been formed, and for the simple reason that, even if an answer were possible, the standard at our command is insufficient. What we ask is, whether a stratum has been formed before, after, or simultaneously with another given stratum? To answer this question, we possess the same means as geology; and these must be applied to determine the chronology of prehistoric human epochs. The determination of the relative epochs within which a deposit belonging to prehistoric periods had taken place, belongs exclusively to the geological method; and I do not hesitate to ascribe many of the contradictions in this respect, solely to the ignorance of the respective authors of the proper geological method. In order to show this, let us examine the means applied to geology, and their relative value.

The geological character occupies the first place. Here is a stratum of red sandstone overlying a stratum of grey limestone, and beneath a layer of light grey lower muschelkalk (Wellenkalk). At some distance I find exactly the same red sandstone, in the same relative position between these two limestone strata; surely I cannot hesitate to assume that the two sandstone strata had been deposited at the same time, and at the same relative period, before the light grey "Wellenkalk" and the smoky grey magnesia limestone. The geological character thus partly depends upon the mineralogical property, and partly upon the relative position to other known strata. This character may surely be applied to the determination of the various beds in the diluvium. When Prof. Fuhlrott shows that in a grotto of the Neander valley there exists a lehmbed, containing a number of fossil bones and rolled flints, and that this layer corresponds exactly with the lehmbed in which at some little distance the famous Neander skull has been found, this concordance of the geological character affords, if not absolute certainty, at all events the greatest probability, that the Neander skull belongs to the same period in which the animals lived whose bones were found in the so-called Devil's chamber. There can, therefore, be no doubt, that the geological character has a claim to great importance, provided that it refers to localities at little distances from each other, and manifestly subjected to the same conditions. But the geologist who, from the resemblance of the deposits in the Devil's chamber and the Neander grotto, infers their contemporaneous formation, owing to their being scarcely one kilometer distant from each other, this same geologist would, at all events, hesitate to extend such an opinion to Belgian or Franconian grottos; and for this reason, that experience has taught him that de-

posits of more or less variegated lehm with rolled flints, may have taken place in different localities at different periods. Here, therefore, the geological method finds its limits ; applied to limited spaces, it affords reliable facts, which may lose their value as regards distant regions.

I look upon the palæontological character as affording much greater certainty in regard to the inferences which may be drawn from the organic remains found in prehistoric deposits. Let us explain. The distribution of animals and plants upon the globe is not the effect of accident, but the result of local conditions and historical traditions. These latter afford a reason why, in spite of favourable conditions, certain animal forms have not been developed. I must show by an example what I mean. An experience of three centuries has shown that America is an excellent field for horses ; nevertheless the type of solipeds did not exist in that part before its discovery. The finding of horse bones in an alluvial bed of America, would therefore irresistibly show that this bed has been forming after the introduction of the horse by Europeans ; whilst the original absence of the horse type proves that, at the time when solipeds were developed in the Old World, they had no access to the New World. The extinct species, the emigrated forms, still existing in other parts of the globe, the domestic animals gradually acquired, offer a like certainty in relation to the determination of a relative epoch, as the horse bones in the above example. Their bones found in the deposits, are speaking witnesses that they existed at the time the deposits were forming, and offered, therefore, the surest indication for determining that period.

This applies equally to plants. The changes in the flora of Denmark during the prehistoric period have been accurately traced, and, although computed by the elements of the present flora of Central Europe, they are still determinative for certain epochs. The same may be asserted of the pile-work periods in Switzerland and Italy. Even the relative frequency of many plants, as well as the cultivation of edible plants, partly taken from the primitive flora, partly introduced from other countries, may serve for an accurate determination of definite periods. The continuation of such researches, as pursued by Lartet, Rüttimeyer, Croizet, and Heer, will afford important contributions to the question of determining the periods to which the finds belong.

At present we cannot assign to the anthropological character, namely, the quality of the human bones, and especially of the skull, such importance as regards the determination of age, as possessed by the preceding elements. It certainly seems that already, at the beginning of man's appearance in Central Europe, as far as we know, several cranial types opposed each other, and that several of these

types succeeded each other in the peopling of certain regions. But, with the scanty materials for the craniology of the olden times, and the duration of the various cranial types, which manifests itself by the intermixture of immigrants with previously existing tribes, the examination of a single or of several crania can scarcely lead to a sound inference regarding the relative age of the same. The masterly investigations of His and Rüttimeyer on the Swiss cranial types and intermixtures in the Romanic districts, show what interesting results may be obtained ; but they give no accurate information concerning the period in which these cranial types appeared. Let us instance that much talked of Neander skull. Its great antiquity is proved, as already stated, by its geological character. The dispute is whether it be a pathological product, an abnormality produced by premature synostosis, or a normal form. The balance inclines to the latter view, for there are many skulls presenting an early closure of the sutures, without showing the particular form of the Neander skull ; and there are also skulls very much approaching the Neander skull, showing no such early closure of the sutures. We therefore assume that the Neander skull belongs to the highest antiquity, and to a peculiar type. Do we, then, say that every cranium of this kind which may be found must belong to that period ? By no means. This Neander people have propagated like other peoples ; they surely have intermixed more or less with other tribes ; and, although it has disappeared as a tribe, be it by gradual extinction or by transformation of its original cranial forms, there have remained remnants which, partly by atavism, have continued down to a recent period.

Finally there comes, so to speak, the industrial character, which is important so far, inasmuch as the introduction of metals, of bronze and iron, must have caused a great revolution in the public and domestic life of man. That this change could only be gradual, that the old implements continued in use for a long time after more perfect instruments were manufactured is clear enough. We have seen even in our rapidly-progressing period that it is perhaps easier to effect a revolution in our government than to change domestic arrangements. If we proceed still further, and endeavour to determine different periods from the polish and workmanship of stone implements, the results will scarcely be in accord with the requirements of accurate investigation. Man with every progress he makes has a desire to render his existence more agreeable. He will therefore at first hammer away and sharpen the edges of his rude hatchets, then polish them ; he will then with this knife, work, carve horn, and he will do so in proportion as his struggle for existence leaves him time for apparently useless occupations. But as in our present civilisation epoch there are many

regions where man requires his whole time for the acquirement of the necessities of existence, so must it in greater degree have been in primitive times; and thus it might have come to pass, that whilst in one district civilisation had sufficiently progressed for the manufacture of more perfect implements, those of adjoining districts were still in a rudimentary condition. Do we not possess an instance of this difference in the settlements of Concise on the Neufchatel lake and the implements of Middle and Eastern Switzerland? If these settlements were overlying each other, if above the rude implements of Robenhause were found the neatly worked implements of Concise, it would at once have been inferred that we had before us two successive culture epochs. Nevertheless these settlements might very easily have co-existed, although in one civilisation appears to have made greater progress than in the other.

In shortly recapitulating what we have said concerning the method to be applied for solving the problems in question, we come to this general inference; that no single character possesses an absolute value, and that only by the combination of all, with special reference to circumstantial conditions and limited localities, valid conclusions may be arrived at. When the facts shall have accumulated to such an extent that they embrace countries hitherto unexplored, and of which some had in certain respects attained degrees of civilisation before the already explored regions, then shall we be able to penetrate deeper into the mysteries of the primæval history of our species.

We must now be permitted to enter upon the results hitherto obtained. If partly in contradiction with the views we have advanced, we still divide them into sharply demarcated periods, it is not because we believe in no transitions and intermediate periods, but simply from the necessity of succession and separation.

If, then, we speak of cave-bear or reindeer periods, we protest at the outset against the assumption that the first reindeer was born on the day the last cave-bear died. We are permitted to assume that the form of the cave-bear has been gradually developed into that of the common brown bear; that the reindeer, which was partly contemporaneous with the cave-bear, and acquired greater importance for man, disappeared, like the cave-bear, but gradually, and retired very slowly from the south to its present habitation. These epochs we denominate, according to the chief character they represent, transition periods: we acknowledge their importance as forming the central reflex of a long period.

The oldest traces of man, if they can be attributed to him, have been laid bare by M. Desnoyers in the sand of Saint-Prest, near Chartres. This sand-pit is situated on the banks of the Eure,

covered above by lehm of considerable thickness ; then come beds of rolled flints and rounded blocks of sandstone, pudding-stone, white sand, mingled with rolled flints ; then very fine sand resting upon chalk. This mode of stratification, that of the sand deposits in which the bones of large mammals are found, is unquestionably older than the diluvial formations occurring in this country or in other districts of France, and that they belong to the upper tertiary strata found in the valley of the Arno, in France and England. The Norwich crag and the deposits of Grays-Thurrock and Ilford in the Thames valley, which at all events were formed before the glacial period, belong to the same period. In the known Norfolk cliffs, near Cromer, in the so-called forest-bed, and unquestionably underlying the glacial mud, there are found, according to Lyell, the following plants as determined by Heer: *Pinus sylvestris*, *Pinus Abies*, *Taxus baccata*, *Prunus spinosa*, *Menyanthes trifoliata*, *Nymphaea alba*, *Nuphar luteum*, *Ceratophyllum nemorosum*, *Potamogeton*, *Alnus*, and *Quercus*, and bones of the following animals, as determined by Falconer, Owen, and others: *Elephas meridionalis*, *Elephas primigenius*, *Elephas antiquus*, *Rhinoceros Etruscus*, *Hippopotamus* (major?) *Sus*, *Equus* (fossilis?), *Bos*, *Cervus capreolus* (?), and other species of *Cervus*, *Arvicola amphibia*, *Castor trogontherium*, *Castor Europæus*, and *Cetacea*. In the valley of the Arno were found, *Elephas meridionalis*, *Rhinoceros leptorhinus*, *Hippopotamus major*, large oxen, stags, and one horse, all differing from the species found in the alluvium. At St.-Prest were found, *Elephas meridionalis*, *Rhinoceros leptorhinus*, *Hippopotamus major*, several species of deer, one of which, on account of its resemblance to the large Irish deer, was called *Megaceros carnutorum*, whilst the teeth of the other species of deer quite resembled those found in the Arno valley ; further, one horse and one species of ox, corresponding with those found in the Arno valley, and also an extinct species of rodent of the size of the beaver, called by Laugel *Conodontes Boisviletti* ; there obtains, therefore, despite of the difference in localities, a concordance between the deposits, so that, on geological principles, the contemporaneity of these deposits in England, France and Italy is undoubted. Whether these deposits are belonging to the upper tertiary, so-called pliocene, or to the diluvial formation, is a purely theoretical and idle question, inasmuch as the division of the formations usually adopted in geology are purely arbitrary. But the relative age of these deposits is sharply demarcated. The deposits in Norfolk and at Saint-Prest prove that they have unquestionably taken place before the glacial period, and before such formations in which the later contemporaries of man—the cave-bear, the mammoth and *Rhinoceros leptorhinus*—have left us their bones.

If the proofs for the existence of man were as convincing as those for the age of these animals, no one could doubt of his great antiquity. But these proofs only consist of carvings, lines and stripes, certainly not unlike those found in caves and kitchen middens carved on the bones with flint knives. The crania of the large deer are almost all at the root of the antlers, broken as from a blow on the frontal bones, in the same way as Steenstrup has found in certain deposits, and as is still practised by the Laplanders. The antlers are broken into two pieces, apt to form handles of implements. The incisions are specially marked on the long bones of the elephant, but also on those of the rhinoceros and hippopotamus. That these incisions existed upon the bones before they were covered with sand, is proved by the sand being fixed in the incision, so as to refute the objection raised at the Ecole des Mines of Paris, that these incisions were caused by scratching the bones with iron instruments. Besides these incisions, there are seen in these bones other light scratches, which Desnoyers attributes to the friction of flints.

Whosoever has once seen bones from caves, pile works and kitchen middens, from which the flesh and the tendons had been removed by stone-knives, he cannot fail to mark the resemblance to the incisions discovered by Desnoyers. The experiments suggested by Lyell have however established that similar incisions might be produced by large rodents, and as such rodents are not altogether absent in Saint-Prest, the discoveries of Desnoyers have lost much of their validity in relation to the existence of man in the tertiary period. It must certainly be added that prejudice only, and not a rational contemplation of nature, can adduce well grounded reason against the existence of man in that remote period. If man at this day can inhabit the same countries, by the side of the elephant, the rhinoceros, hippopotamus and similar beasts, why should he not at a remote period have found the condition of his existence by the side of these animals? This epoch of the primeval period, if it should be confirmed, might be called the epoch of the southern elephant (*Elephas meridionalis*).

Since the first undoubted traces of man consist of rude flint implements, so-called hatchets and knives, and later of bones, found in the diluvium of the Somme valley, we shall treat of these first. These kinds of deposits may be designated as the epoch of the cave-bear and the mammoth.

There is no doubt that all such deposits of Central Europe, in which whole skeletons and limbs of the mammoth and the fossil rhinoceros are found, correspond with that epoch in which, around the Alps, the glaciers began to retire. But if this be a fact, doubts certainly may arise whether these diluvial formations, in which flint

implements are found, really belong to the mammoth beds, or whether the teeth of the pachydermata, and other bones found in them, might not have been carried away by the waters from other localities and deposited in the spots where they are found. The geological character was therefore doubted, because it was assumed that the diluvium in which the implements were found had been produced from the destruction of earlier mammoth beds, and was consequently of a later origin. But as the diluvial formations in the river valleys present the general character of stream formations, as they without exception consist of rolled flints, sand and gravel, and present that confused stratification peculiar to river deposits, this view seemed plausible. The thickness of more recent strata which cover the sandbanks containing flint implements could not well be invoked as a proof for their age, it being known that rivers frequently change their beds, and may within a few centuries in some spots accumulate deposits, whilst in other places they carry off huge masses in order to redeposit them lower down their banks.

The geologists who had studied the superficial formations, especially of France, had a full right to invoke the parallelism of the strata; they called to mind that the various deposits in adjoining regions presented the same succession as regards the composition of the banks of variously formed rolled flints. But all these considerations afforded only probability, not certainty. An Italian naturalist, B. Gastaldi, had therefore a perfect right to maintain that the finding of flint hatchets associated with mammoth teeth does not prove the contemporaneity of these deposits, which can only be proved if, as in Italy, whole skeletons, or at least all the bones composing them, are found in one spot. Single teeth and other bones may, like rolled flints, be carried off and deposited elsewhere by streams, whilst the deposit of a skeleton or bones in their relative position proved at least that the whole body, kept together by skin, muscles, and sinews, had been deposited. It did not occur to B. Gastaldi that when he raised this objection it had already been refuted as regards the Somme valley. These deposits, at Cuvier's time, already passed for the richest localities in which bones of the mammoth and fossil rhinoceros were met with; and more than thirty years ago, a Monsieur Baillon has, in the sands of Menchecourt, which yielded many stone hatchets, found a perfect hind foot of the rhinoceros, the bones of which were found in their normal position, whence Baillon justly inferred that these bones, when they were deposited, were still united by muscles and tendons. The skeleton of the whole animal to which this foot belonged was at a short distance from it. At the time when this discovery was made and published,

the existence of hatchets in the same bed was not even anticipated, nor its relation to later discoveries.

Very recently a perfectly valid confirmation of this deposit was found on the banks of the Manzanares at Madrid, in the vicinity of San Pedro, by Casiano de Prado. The stratification is as follows. Immediately beneath the vegetable earth lies a confused mass of sand and rubbish, with few rolled fragments, of the thickness of 7 mètres and 80 centimètres, overlying a lehm stratum 30 centimètres in thickness throughout. Then comes a layer of sandy lehm 70 centimètres thick, in which, in the year 1850, was found an almost perfect skeleton of an elephant, the bones of which were partly in their relative positions. About four or five years ago were found, in the same stratum, bones of a mammoth in a similar condition. There can, therefore, be no doubt that the waters which deposited this bed had carried off the whole bodies of these elephants, and that consequently the bed was deposited at the period when elephants lived in the vicinity of Madrid. Under this stratum was found a mass of rolled stones three mètres in thickness from the underlying tertiary formation, in which were found flint hatchets resembling those of the Somme valley, being neither polished nor sharpened, but solely formed of fractured flint lumps. This discovery removed every doubt. We might, from the overlying strata infer that the man who made the flint hatchets existed even before the mammoth, were it not that we find everywhere proofs that the beds which, beneath present rolled flints, but above a finer material, have been formed in the same epoch, although in different successive times.

The geological character of this first epoch being determined, the palæontological character is no less so. It is unnecessary to dwell long upon this. In my *Lectures*, I have stated that the mammoth, the fossil rhinoceros, the hippopotamus, the fossil horse, the large beaver, characterise these beds; and that, besides them, several species of deer, oxen, goats, and sheep, are not rare in the diluvial formations; while the cave animals, such as bear, hyæna, tiger, and leopard, belonging to extinct animals, are rarely found in the diluvium, but mostly in caves. Doubts might certainly arise as regards the contemporaneity of these deposits, were it not that in the diluvium large bones of carnivora have been found, whilst in the caves the bones of pachydermata and ruminants were met with, which had been evidently imported there by beasts of prey, as the bones still bear evidence of the traces of their formidable teeth.*

* In a little work by M. Troyon (*Recherches sur l'âge de pierre quaternaire*, etc.) which has just reached me, I find a note, according to which Dartet still divides the first period into four different epochs—that of the cave-bear, of

I must at the same time repeat, that many of the extinct species which we find in Central Europe, have gradually retired to the north, where probably they existed longer than in Central Europe; whilst other animals, like the reindeer, the elk, the aurochs, the musk-ox, the gulo, the myoxus, the marmot, the ibex, and the chamois, have partly retired to the north, and partly to the mountains, where they still live; others again, like the stag, the wolf, several species of oxen and swine, have remained, and live among us either in a wild or domesticated condition. Whilst these facts prove that the epochs of the cave-bear and the mammoth were richer in mammals than the present epoch, we find, on the other hand, that the gradual extinction and retirement of the various species within an epoch of long duration, afford us the means of separating individual sections of time. The finding of remains of extinct animals in Central Europe, will thus enable us to separate the earliest epoch, that of the mammoth and cave-bear.

On searching for anthropological character in the deposits of the diluvium, it is reduced to the celebrated jaw of Moulin-Quignon, and to the cranium latterly found there, the description of which we have yet to expect. The other scanty remains of bones and teeth, which are found here and there, do not possess any importance as regards the determination of race.

The industrial character is confined to the various flint implements. Despite many objections, they have proved themselves works of art. They show everywhere the same character, presenting no traces of polish or grinding, rudely struck off from flints, and have been further worked according to the form given them by accident or a skilful direction of the blow. But heaven forbid that we should, from this the mammoth, of the reindeer, and of the aurochs; a division which Lartet first proposed in his description of the grotto of Aurignac. I must confess not to understand the grounds upon which this division rests. Cave-bear and mammoth have always been found associated. Schmerling enumerates the mammoth and the rhinoceros among the remains of the Belgian bone caves. There is no evidence that either of these animals appeared successively, or that one became extinct before the other. The finding of whole mammoths and rhinoceros in the icy Siberian diluvium, cannot be adduced as proof that they became extinct later. We should probably in our region have found, instead of skeletons, the entire bodies of elephants, if here the ice had increased instead of decreasing. This also applies to the distinction of the two other epochs, those of the reindeer and the aurochs. Both occur with the cave-bear and the mammoth (Schmerling found reindeer antlers in the Belgian caves). Both retired to the north, and have, like the human species, outlived their former contemporaries. The aurochs seems in France to have lived even later than the reindeer; but we know of no facts affording a satisfactory proof that the aurochs, after the retirement of the reindeer, characterises a special prehistoric epoch.

circumstance, conclude that all such rudely worked flint implements, or their cast away nuclei, belong on this sole ground to the first epoch. Already, in the earliest period of human society, there must have obtained a certain division of labour; and many spots where many implements were found are justly looked upon as manufactories where the stonemen, as we may call them, first rudely worked suitable flints, in order subsequently, perhaps, to polish and grind them with ears for handles, etc. Where other characters for determining the age are wanting, we are perfectly justified in suspending our judgment, as regards the antiquity both of the rude implements and of the nuclei from which they were struck off, until other proofs are forthcoming. As an instance, I may mention the large flint nuclei, the so-called butterstones of Grand Pressigny, which have given rise to so lively a discussion between some members of the Academy and M. de Mortillet. These large blocks, of peculiar grain and quality, from which long flint knives had evidently been struck off, of which some have recently been found under the vegetable earth, were by some members looked upon as the remnants of a large manufactory of gun-flints, which had existed on that spot within a comparatively recent time. This assertion was successfully refuted by competent judges, such as Pengully P'Haridon, director of the Paris artillery museum, and Mr. John Evans, both on historical and manufacturing grounds. I have myself, after inspecting the fragments collected by M. de Mortillet, become convinced that the fabrication of gun-flints by means of steel instruments, which, from the invention of the flint-lock down to the introduction of percussion-caps, obtained in France and England, never left remnants like these butterstones. The latter are frequently more than a foot in length, and consist of a peculiar coarse-grained flint with a waxy lustre, and was from its toughness unfit for gun-flints. It has, moreover, been shewn from the archives that a gun-flint manufactory had never existed near Pressigny. Such butterstones have, moreover, frequently been found in walls erected long before the use of gun-flints. But, whilst all this militates against the modern origin of these flint knives, of which many are found in the vicinity, it must, on the other hand, be admitted that the position in which they are found affords no satisfactory proof that these remnants of a flint manufactory belong to the mammoth epoch. The circumstance that some polished fragments, as stated by Evans, were found in the vicinity, rather proves that they belong to a later period.

I merely mention this instance, to show how cautious we should be positively to determine the age from few facts, and a single character not universally valid. A flint knife, intended to be polished, must necessarily be first struck off; and the find of such flakes, as

well as their nuclei, does not prove that they were not subsequently polished. I shall, therefore, say here no more of the many flint implements found in different spots, partly on the surface, or in the vegetable earth, or in sand and gravel beds. Further observation may, perhaps, by the addition of other more positive characters, assign to them a definite place in history ; but, until such characters are found, we should take all these finds *ad referendum*, and rather confess our ignorance, than enter into discussion on subjects which as yet have acquired no scientific certainty.

[*To be continued.*]

THE FOSSIL HUMAN JAW FROM SUFFOLK.

BY ROBERT H. COLLYER, M.D.

At the instigation of Vice-Admiral Sir Edward Belcher, C.B., I was induced to exhibit to the Ethnological Society of London in April 1863, a fossil or coprolite human jaw, which was found by the workers employed in excavating coprolites near Ipswich, Suffolk.

The jaw was purchased from the finder by Mr. John Taylor, druggist, of Ipswich, for the sum of 2s. 6d., who called my attention to it at the time, 1855. A small portion of the bone was filed off, which, on the application of heat, emitted a slight odour peculiar to burnt gelatine, showing conclusively that the whole of the animal matters of the bone had not been fossilised. As this, to my mind, is no criterion that the bone did not belong to a period coeval with extinct mammals, I was very anxious to become the possessor of this "coprolite jaw." The specific gravity is much greater than that of a recent bone of the like size, it being infiltrated throughout its entirety with oxide of iron, and the surface presents peculiar metallic lustre. The condyloid processes are one-and-half inches distant from the alæ, and from the condyles to the posterior angular protuberance it recedes full 45°, and the same receding angle is shown from the mentum prominens to the alveolar processes of the place formerly occupied by the incisor teeth ; the bone probably was that of a female of small stature, and as the alveolar portion of the jaw, where the incisor teeth were inserted, is closed, and the molar teeth ground down, I am of opinion that "the human" tore the food prior to mastication by the molars. The cranium of this jaw must have been very small, with a contracted low frontal region. I have now every reason to believe that this "coprolite jaw" is the oldest relic of the human animal in existence, as its